DOCUMENT RESUME

ED 111 665 SE 019 634

AUTHOR Engle, H. A.; Christensen, D. L.
TITLE Identification and Evaluation of Educational Uses and Users for the STS. Executive Summary. Educational Planning for Utilization of Space Shuttle (ED-PLUSS). Final Research Report.
INSTITUTION Alabama Univ., Huntsville.
SPONS AGENCY National Aeronautics and Space Administration, Huntsville, Ala. George C. Marshall Space Flight Center.
PUB DATE Feb 75
NOTE 42p.; For a separate edition of the Final Research Report, see ED 104 429
AVAILABLE FROM The final research report described in the abstract is available on microfiche from ERIC/SMEAC, The Ohio State University, 400 Lincoln Tower, Columbus, Ohio 43210 (on loan)

EDRS PRICE MF-$0.76 HC-$1.95 Plus Postage
DESCRIPTORS *Aerospace Education; Aerospace Technology; Earth Science; *Educational Planning; Educational Research; *Instruction; Program Planning; Research; Science Education; *Space Sciences; *Telecommunication
IDENTIFIERS *Space Shuttle Space Lab

ABSTRACT

Reported is a study to consider the educational uses of the space shuttle/space lab. Several specific tasks were identified and accomplished during the study and the summary addresses itself to five that are considered pertinent: (1) Potential User and Identification; (2) Identification and Analysis of Space Education Programs; (3) Planning Methodology for User Involvement; (4) Techniques and Programs to Encourage New Users; and (5) Compiling Follow-On Ideas. Conclusions and recommendations of the study team are reported. The document also includes a copy of an interview held with Dr. Wernher von Braun, Vice President, Engineering and Development of Fairchild Industries, soliciting his comments and suggestions on educational applications for the Space Shuttle/Spacelab (SS/SL) Program. (Author/EB)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED111665

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

SE

EXECUTIVE SUMMARY

IDENTIFICATION AND EVALUATION OF EDUCATIONAL USES AND USERS FOR THE STS

Working Title For This Study

EDUCATIONAL PLANNING FOR UTILIZATION OF SPACE SHUTTLE (ED-PLUSS)

By

H. A. Engle and D. L. Christensen

Final Research Report

This research work was supported by
the National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Contract NAS8-30737

February 1975

SE019 634

EXECUTIVE SUMMARY

EDUCATIONAL PLANNING FOR UTILIZATION OF SPACE SHUTTLE (ED-PLUSS)

Contract NAS8-30737 February 1975

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MARSHALL SPACE FLIGHT CENTER
HUNTSVILLE, ALABAMA

Dr. Harry A. Engle
Principal Investigator

David L. Christensen
Co-Principal Investigator

Harold. R. Green
Consultant

FOREWORD

The Educational Planning for the Use of Space Shuttle (ED-PLUSS) study was conducted by The University of Alabama in Huntsville, Alabama, for the National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Alabama. The study was conducted from March 1974 to September 1974 under contract NAS8-30737, with contract extensions through February 1975.

This document presents an executive summary of the study work and is submitted by the University of Alabama, Huntsville, to briefly summarize the total project.

The ED-PLUSS team operated under the direction of Dr. Harry A. Engle, Principal Investigator. It received guidance and counsel from an advisory committee of faculty and staff members of the university. The members of this advisory council are:

Dr. J. J. Brainerd
Dr. Thomas Brindley
Dr. Thomas Dowdle
Dr. Larry Doyle
Dr. John Gregory
Dr. Rudolf Hermann
Dean J. Hoomani
Dr. Kenneth Johnson
Dr. Richard Leonard
Dr. Abbas Mirakhor
Ms. Carol Roach
Dean John G. Rogers
Dean J. E. Rush
Dean Gayle Stephens
Dr. K. O. Thompson
Dr. Hans Walter
Dr. Shi-Tsan Wu

Questions concerning this study may be directed to:

Dr. Harry A. Engle, Principal Investigator
University of Alabama in Huntsville
P. O. Box 1247
Huntsville, Alabama 35807
Telephone: (205) 895-6180

David L. Christensen, Co-Principal Investigator
University of Alabama in Huntsville
P. O. Box 1247
Huntsville, Alabama 35807
Telephone: (205) 895-6257

TABLE OF CONTENTS

		Page
1.	INTRODUCTION AND GENERAL BACKGROUND	1
2.	STUDY OF CONCLUSIONS AND RECOMMENDATIONS	2
3.	TASK 1 IDENTIFY LEVELS OF POTENTIAL EDUCATIONAL USERS OF SS/SL	3
4.	TASK 2 A REVIEW OF SPACE EDUCATION PROGRAMS	5
5.	TASK 3 DEVELOPMENT OF METHODOLOGY FOR USER INVOLVEMENT	9
6.	TASK 4 METHODS TO ENCOURAGE USER AWARENESS	16
7.	TASK 5 COMPILE "FOLLOW-ON" IDEAS	17

INTRODUCTION AND GENERAL BACKGROUND

The charter of the National Aeronautics and Space Administration, as set forth in the Space Act of Congress, requires that NASA provide widespread dissemination of information concerning its activities and their related results. Considerable efforts have been expended toward meeting this objective through various NASA educational programs. Additional efforts are now being made to apply space technology more directly to the educational process through demonstrations using telecommunication satellites such as the Application Technology Satellites (ATS) and the Communications Technology Satellites (CTS).

Interest in the use of space technology for educational purposes is wide-spread in NASA. Dr. James C. Fletcher, Director of the agency, in a statement to the U. S. Senate Committee on Aeronautical and Space Sciences in 1974, commented: "Better communications (resulting from space exploration) will be used in a lot of different ways. Education is the first application that we see very clearly, because we need, even in the high schools, access to large-scale digital computers." Other NASA officials have made similar comments at other times that support the view that education has a great stake in space exploration as typified by the SS/SL program.

The Space Shuttle/Space Lab transportation system will be able to carry into low earth orbit on a repeating basis, in a "shirtsleeve" environment, an endless variety of experiments and working forces for the construction of space habitations and manufacturing enterprises. This will provide opportunities for educational use of the unique characteristics of space.

NASA is preparing programs for the development of new uses and users of the SS/SL system in industry and government. Part of the current planning effort is the development of new educational programs and applications to improve public awareness of the SS/SL capabilities. The University of Alabama in Huntsville was selected by NASA-MSFC to perform a Phase I planning and feasibility study to identify and document a methodology needed to incorporate educational programs into future missions and operations of the STS.

Several specific tasks were identified and accomplished during the course of the UAH Phase I study. This summary will address itself to five that are pertinent, in the order they appear in the final report of the study. They are as follows:

- Task I - Potential User Identification
- Task II - Identification and Analysis of Space Education Programs
- Task III - Planning Methodology for User Involvement
- Task IV - Techniques and Programs to Encourage New Users
- Task V - Compiling "Follow-On" Ideas

The conclusions and recommendations of the study team appear following the introduction and background.

SUMMARY OF ED-PLUSS CONCLUSIONS

The research efforts of the ED-PLUSS study team have led to the following conclusions and recommendations concerning the educational community and its potential relationship to the SS/SL.

- The ED-PLUSS team concludes that the educational community can be a substantial user of SS/SL capabilities.
- Any implementation of a high priority program for education should increase interest in SS/SL in all sectors of American life.
- The present lead time in the development of the SS/SL is compatible with the long time span necessary for educational change. Educational uses for the SS/SL might be developed by the time the SS/SL is ready to function.
- All educational levels, particularly Level III, need a more detailed in-depth study for potential uses and users than was possible in the Phase I effort.
- The size of the educational user community will depend on the number of capabilities of SS/SL developed and the depth of understanding the educational community has of their applicability.

SUMMARY OF ED-PLUSS STUDY RECOMMENDATIONS

Any conclusions derived from a study can be a basis for a valid recommendation. These recommendations relate directly to the foregoing conclusions. The ED-PLUSS team recommends:

- That NASA should immediately begin an effort to include education as an integral part of the SS/SL program.
- That educational applications of the SS/SL capabilities should receive high priority from NASA, as both a key user and a catalyst for all SS/SL user sectors.

- That development of educational applications for SS/SL capabilities should begin immediately.
- That NASA should develop a series of methodologies to link specific SS/SL capabilities to specific educational objectives.
- That NASA define all possible SS/SL capabilities and initiate programs to broadly disseminate these capabilities to educational institutions.

TASK I: IDENTIFY LEVELS OF POTENTIAL EDUCATIONAL USERS OF SS/SL AND THEIR CHARACTERISTICS

For the purposes of this study the educational community is defined as the total U. S. population directly involved with education. For convenience it is divided into three levels, each distinguished by special characteristics but generally similar in function and purpose. These levels are identified below:

GRADE SCHOOLS (LEVEL I) Public and Private

- Early Childhood
- Elementary Schools
- Middle Schools
- Secondary Schools

HIGHER EDUCATION (LEVEL II) Public and Private

- Junior Colleges
- Technical Institutes
- Community Colleges
- Liberal Arts Colleges
- Land Grant Colleges
- Multipurpose Universities

OTHER (LEVEL III) Public and Private

- Adult/Continuing Education
- Correspondence Schools
- Education in Industry
- Vocational/Technical Education
- Military Technical Schools

The vast area of education outside of Level I and Level II institutions constitutes, for the purposes of this study, Level III. It is by far the largest single educational grouping in this country. It includes nearly two-thirds of the population at any given time. It ultimately receives every citizen.

Level I Description and Characteristics

Categories in Level I and their Characteristics

Early Childhood Education--Schooling, in the home or in institutions, of 3 to 5 year old children has for its purpose to assure healthy physical development and prepare children for the elementary school.

In 1972 over 4.23 million of an eligible 10.16 million children were enrolled in public or private programs of education. Exact funding figures are not available, but in 1974 the federal government provided 260 million dollars to support various early childhood programs. Because much of this takes place in homes, television becomes an important factor in its success.

Elementary, Middle and Secondary Schools--This category consists of those educational programs designed to guide the physical, social, intellectual, and moral growth of children from 6 to 18 years of age. They are intended to further the basic national educational goals, which are, briefly, (1) to assist each student to achieve optimal development of his physical, mental, emotional and social potentials, (2) to provide a foundation of knowledge necessary for the development of values essential to the maintenance of a democratic society, and (3) to prepare students to enter higher education or the labor force.

The 1972 population of the schools in this category was approximately 51 million children. It is expected to drop to 45 million by 1982, reflecting some of the population trends visible at the present time. Expenditures for this category reached 57.0 billion dollars in 1972 and if present trends continue, will rise to 70.4 billion dollars in 1982.

Level II Description and Characteristics

Level II schools consist of those two-year and four-year program schools known generally as junior colleges, colleges, and universities. Enrollment of the present 946 junior colleges is approximately 2.9 million students (1972). By 1981 this should increase to 4.3 million. The 1701 four-year institutions, of which 159 are universities, enrolled 8.3 million students in 1971 and should be enrolling 8.9 million by 1982. This, of course, presupposes that the present recession will not be a permanent deterent to attendance in higher education.

In 1972 Level II institutions spent 32.1 billion dollars. This is expected to rise to 44.1 billion by 1982. Level II institutions serve the vital purpose of providing the facilities and environment for students to pursue advanced studies in many discipline areas and prepare themselves for work in these areas on a professional level.

Level III Description and Characteristics

All the sources of education not listed in the other levels fall into this category, whether funded by government, industry, or sought after by individuals for their own purposes.

For those who do not attend Level II institutions and for those who complete the work offered by them, the remainder of their lifetime educational experiences will be in Level III. It may be as part of their job experiences or as part of some government-funded adult education program, or something the individual wishes to learn at a convenient time and place, but some form of education will occur in each person's life till the time of death. Very little is known about the details of this area, but government sponsored adult and vocational courses account for about 3 billion dollars of federal investment and industry has invested up to 15 billion dollars (1972) in a single year in all forms of learning. How much is spent by the military and all the various private schools of business, etc. may never be known, but is without doubt a very considerable sum of money, since it involves expenditures by about 135 million people.

TASK 2 A REVIEW OF SPACE EDUCATION PROGRAMS

A brief review of space educational programs is included in this study for two reasons: (1) to establish a baseline of information necessary for determining what types of NASA educational activities have occurred in previous, as well as in on-going, projects; and (2) to provide a necessary data base for the development of a new user methodology in Task 3 of the ED-PLUSS research study.

In order to establish the background for the on-going NASA interface with the educational community, it is necessary to consider its historical development. The original NASA Charter of 1958 specifies a requirement for the widespread dissemination of data relevant to its space activities. By its Charter, NASA is "to provide for the widest practicable and appropriate dissemination of information concerning its (NASA) activities and the results thereof". NASA has acted accordingly and for more than a decade has maintained a variety of meaningful relationships with the educational community.

NASA Offices Involved with Education

Several offices within NASA have been primarily involved with the educational community. These are the Office of University Affairs, Office of Public Affairs, and a selection of Program and Project Offices. This summary discusses relationships of each of these offices to the educational community and wieghs these relationships in light of new applications of SS/SL.

Office of University Affairs

Much of the basic research of the space program could not have been accomplished so soon had not NASA taken advantage of the wealth of skills and resources of the nations' universities. In order to tap these resources, the OUA contracted with a total of 280 universities for over 2,600 research projects pertinent to its needs. Facilities were constructed, staffs trained and research programs were begun. NASA activities such as Research Grants and Contracts, Research Facilities, Multidisciplinary Research, and the Resident Research Associate Program are examples of some of the OUA programs.

The activities of the OUA have had a significant impact on the universities involved in the programs. Both NASA and the universities have benefited and in many cases a permanent relationship has been established that will continue into the SS/SL era. Funding of these programs has exceeded one-hundred million dollars.

Office of Public Affairs

This office administers the Educational Program Division of NASA. Activities included in its function are publication of educational materials, preparation of teacher resource kits, speaker bureau presentations, media announcements, and others. The OPA will no doubt serve as an initial mechanism for contact with any potential educational user of the SS/SL.

Program and Project Offices

Approximately two-thirds of the money that NASA has invested in universities has been through its program and project offices. These various offices include within their scope of activities the extension of research contracts to universities, as well as more specific educationally dedicated programs. They utilize the faculty and staff members of universities for support of many projects ranging from multidisciplinary research in the space sciences to the investigation of such specific subjects as "Crystal Growth in Zero Gravity".

Model Programs With Potential SS/SL Applications

The ED-PLUSS team considered the necessity of investigating several NASA programs with educational impact. They identified the Skylab Student Experiment Program, educational utilization of Skylab data, and the Applications Technology Satellites (ATS) series, with emphasis on ATS-6, as significant programs. Each of these will be discussed and the conclusions for potential application summarized.

Skylab Student Experiment Program

The Skylab Student Experiment Program was directed by Mr. Henry Floyd of the Skylab Project Office at Marshall Space Flight Center in Huntsville. The basic objective of the program was to broaden knowledge about space exploration and its potential educational benefits to high school students and teachers.

In cooperation with the National Science Teachers Association (NSTA), NASA solicited ideas from high school students throughout the country. From more than 3,400 proposals received, the largest number ever received from a project sponsorship, according to NSTA, nineteen projects were finally developed for flight aboard Skylab.

Final evaluation of the experiments are not complete but their value in stimulating interest in science and space has been immense. A continuing program of student participation in space activities in the SS/SL era should, if this program is an indicator, have far reaching benefits to both education and NASA.

Educational Utilization of Skylab Data

The preface to one of the educational sourcebooks concerning Skylab experiments states:

> "The most immediate benefits that derive from a multidisciplined scientific program such as Skylab are a large volume and wide range of scientific information. A secondary benefit is that this very large amount of up-to-date information can be related in a timely manner to high school curricula. The time lag between the generation of new information and its appearance in textbooks is often measured in years rather than in months.
>
> It was the intent of the Skylab Education Program to eliminate this characteristically long delay by timely presentation of scientific information generated by the Skylab Program".

Accordingly, a series of slides, films, filmstrips, teacher guides, and other media have been produced and made available to teachers throughout the country. A multi-volume series of documents were developed under contract to support the total objective.

Concern over apparent inadequate user interest in many of the materials prompted a conference in Houston, Texas, to evaluate the materials that had been produced and were planned for production in the future. The recommendations of the educators relating to educational materials stemming from Skylab and future missions was edited and prepared in the form of a report by the National Science Teachers Association representative. These are described in detail in Appendix B in the final report. In essence, the feeling of the conference members was that the material was still too technical for many teachers and students. Recommendations were made for more direct involvement by more teachers in the design and preparation of such materials. A unanimous feeling was that in the future missions, particularly SS/SL, educators on the teaching level should be involved in all planning for educational output from any of the activities.

Applications Technology Satellites

As a demonstration project to test and improve communication satellite systems, NASA began, in 1966, to orbit a series of Application Technology Satellites (ATS).

On May 30, 1974, NASA launched ATS-6, one of the largest unmanned satellites in orbit. Its function is to test the feasibility of deploying large parabolic antennae and various operating capabilities of large satellites.

Of particular interest to this study was an experiment utilizing the ATS-6 satellite known as the "Appalachian Educational Satellite Project (AESP)". AESP is a communications experiment by the University of Kentucky to demonstrate the feasibility of delivering in-service education courses and supporting information services (in career-education and elementary reading) to teachers in the Appalachian region via satellite.

The success of one stage in the AESP was attested to by the participants of the experiments in a press conference held via ATS-6 from the University of Kentucky to the Appalachian regional centers in August, 1974. Comments about the experience

by teachers attending the courses was very favorable and indicated a definite value in continuing and expanding such activities in the future.

TASK 3 DEVELOPMENT OF METHODOLOGY FOR USER INVOLVEMENT

The basic objective of Task 3 was to develop a methodology for expanding the educational utilization of the SS/SL by the educational community. To meet this objective, a better understanding of the nature and characteristics of potential educational users, and the capabilities and interests of NASA educational programs were required. Tasks I and 2 were necessary before a detailed consideration of applicable methods and techniques could be performed. These inputs included evaluations of the other three Phase I studies and related NASA and contractor studies. Possible application of the SS/SL capabilities as related to educational activities and programs, with a consideration of future events related to all aspects of this definition study were also investigated.

Inputs to Task 3

Task I Input

This task identified and described three basic educational levels with an explanation of needs, purposes, capabilities, resources, and constraints provided.

Task 2 Input

As NASA has demonstrated a basic and continuing interest in educational programs, Task 2 was also considered necessary for the methodology development task. A primary purpose of Task 2 was to provide a better understanding of those NASA educational activities which could serve as models and which could be expanded to allow greater educational utilization of SS/SL.

Other Phase I Contractor Studies

A review was made of the final reports performed by the other three Phase I contractors--Arthur D. Little, Inc., Battelle Columbus Laboratories, and Stanford Research Institute. This review was very helpful in the performance of the overall UAH study. It helped to focus attention on a number of considerations required for the particular SS/SL user community being addressed. The educational community, because of its broad, diverse, and fragmented nature, interfaces with and is a part of domestic and foreign governments, industrial, and, of course, academic elements of the total world community. The results of the Phase I contractor studies

complemented and supported the development of a methodology for possibly expanding the SS/SL utilization to meet the needs of this large user community.

Educational Capabilities of the SS/SL

The overall capabilities of SS/SL are not fully understood or stated at this time. Basic payload capabilities are fairly well known, being determined by thrust power of the shuttle boosters and cargo bay dimensions. Other Phase I contractors have discussed SS/SL capabilities for their market sectors; the UAH study has identified three basic types of SS/SL capabilities having educational implications. These are:

- Telecommunications--Educators are now using communication satellites to address educational needs through demonstration programs. The capability of SS/SL to retrieve, refurbish, and repair satellites in orbit, and the lowering of launch costs, as suggested by Dr. Wernher von Braun, Vice President of Fairchild Industries, Inc. and former Director of the NASA Marshall Space Flight Center, should enhance the feasibility of expanded educational use of near space in the 1980s.

- Educational Utilization of SS/SL Experiments--Several ways that expanded educational use may be made of what experiments are being and are to be conducted in space have come from the ED-PLUSS study. They are as follows:

  - o Principal Investigators from Level I educational institutions--The success of the Skylab student experiment program indicates that there is a large pool of potential Level I participants in space oriented research that will be able to benefit from access to experiments that will be conducted in space by industrial and government investigators. The value to education of participation by high school level students is hard to over estimate. Eventually more students from Level I should be able to see their experiments carried out in space and perhaps visit space for this purpose.

  - o Principal Investigators from Level II educational institutions--These are already participating in the space program on a contract basis for specific projects. The future holds the possibility that college students, as well as faculty, will have open access to space capabilities through the SS/SL for enhancement of their education.

  - o Educational program experiments emanating from orbit--Presently identified disciplines for SS/SL application include most of the physical and technical sciences. A new category covering experiments and programs dedicated primarily to education could help to focus national attention on the use of SS/SL capabilities to address problems of vital interest to everyone in the country, namely, educational problems.

Another area that has not been addressed is the potential for great educational benefits to the society by the involvement of the humanities and social studies in the thinking, planning, and execution of space programs. They could become a great force for support of such programs. In its planning to involve educational communities in space use, NASA could not ignore them.

- Piggy-Back Experiments--It is to be expected that many of the SS/SL payloads will not fully utilize SS/SL capacity. There will no doubt be odd shaped spaces and areas left vacant that could accomodate small "piggy-back" experiments prepared by Level I or II principal investigators. Educational institutions should be encouraged to have experiments ready to fit such openings in planned missions. They could be carried into orbit at zero launch cost, this being absorbed by the primary user of the mission. Benefits to the educational community would be considerable.

- Educational Dissemination Programs--As Task 2 indicates, there is a large amount of educational material concerning space exploration available to the public. These include almost all kinds of media. NASA has demonstrated outstanding capability in preparing these materials for communication purposes. All the communications media, television, print, radio have been utilized to make these materials available to teachers and the general public.

As NASA adds the New User Function to its organization, new approaches should be implemented to develop educational users for the SS/SL. Two major areas of interest that could be of importance are as follows:

- The need for awareness--It is imperative that educational decision-makers be made aware of SS/SL capabilities as soon as NASA decisions are made regarding SS/SL activities. A high percentage of the contacts sampled during the study were not aware of NASA capabilities which could be applied to their needs.

- The need for involvement--It will not be possible for NASA, even with a large NUF, to adequately plan for the application of SS/SL capabilities to the needs and purposes of the educational community without complete and continual involvement of education from the areas involved. It is deemed advisable that as planning progresses in each application program the results of that planning be disseminated as broadly as possible to the educational community so others may sense what aspects of it might be brought to bear on their own problems.

SS/SL Futures Studies

Plans for the use of SS/SL must take into account the study of what the educational system of the country might be like in the near future and how space might contribute to the solution of its problems.

Figure I shows a future scenario relating the identified educational possibilities and potential applications of the SS/SL into a composite view emphasizing the mutually supporting role of Orbiter/Spacelab activities in low earth orbit and educational satellites in geo-synchronous orbit and educational institutions on the ground. These types of scenarios need to be used to help expand the thinking of educators and SS/SL planners as they study potential educational uses of the space system. Study of this scenario will reveal that educational involvement in SS/SL activities is a continuous loop as education contributes to the success of space programs and receives benefits from this involvement. Education is unique in this respect, as other sectors of the society prepare payloads for transportation and plan for exploitation of the results of this activity to the exclusion of other segments of the society.

Methodology for the ED-PLUSS Study

The UAH study has developed a methodology which is generalized in form but which can accomodate a number of variable functions and inputs. A diagram of the development approach for this methodology is shown in Figure 2. It is recommended that NASA apply this methodology development plan and resulting methodologies to each of the three educational user levels described in Task I. To assist this activity, a description of each functional element in the methodology development is given below:

- Requirements and Objectives--This element defines the goal the methodology is designed to help the user reach. In NASA's case it would apply to finding ways to develop new uses and users for the SS/SL program in the educational community.
- Constraints--Policy, financial, physical, situation, organizational and communication barriers must be considered among others, for both the "buyer" and "seller" in this element. In the case of educational applications for the SS/SL, the financial, organizational and communication barriers appear to be predominant.
- Capabilities--These are the items that each party is able to contribute to the meeting of the stated objectives and goals. For purposes of this study this element applies to those of NASA and the educational community. The SS/SL capabilities for educational applications should be considered in any space related goal.
- Statement of Approach--After considering detailed factors developed in the constraints and capabilities elements of the methodology, a statement of approach (and possible restatement of the basic objectives) is required. This provides a translation in suitable terms for the next analytical step.

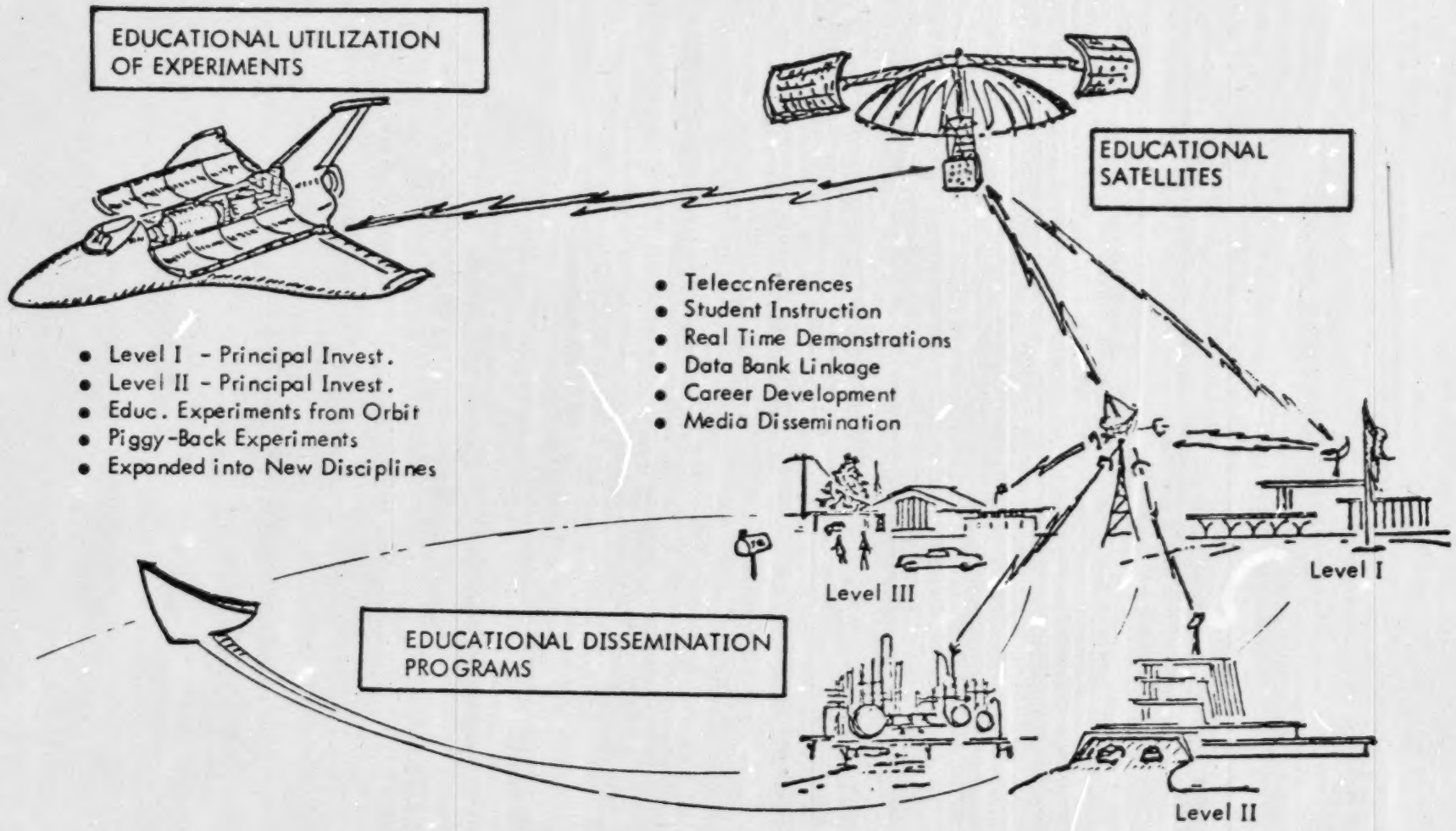

Figure 1. Educational Capabilities for STS

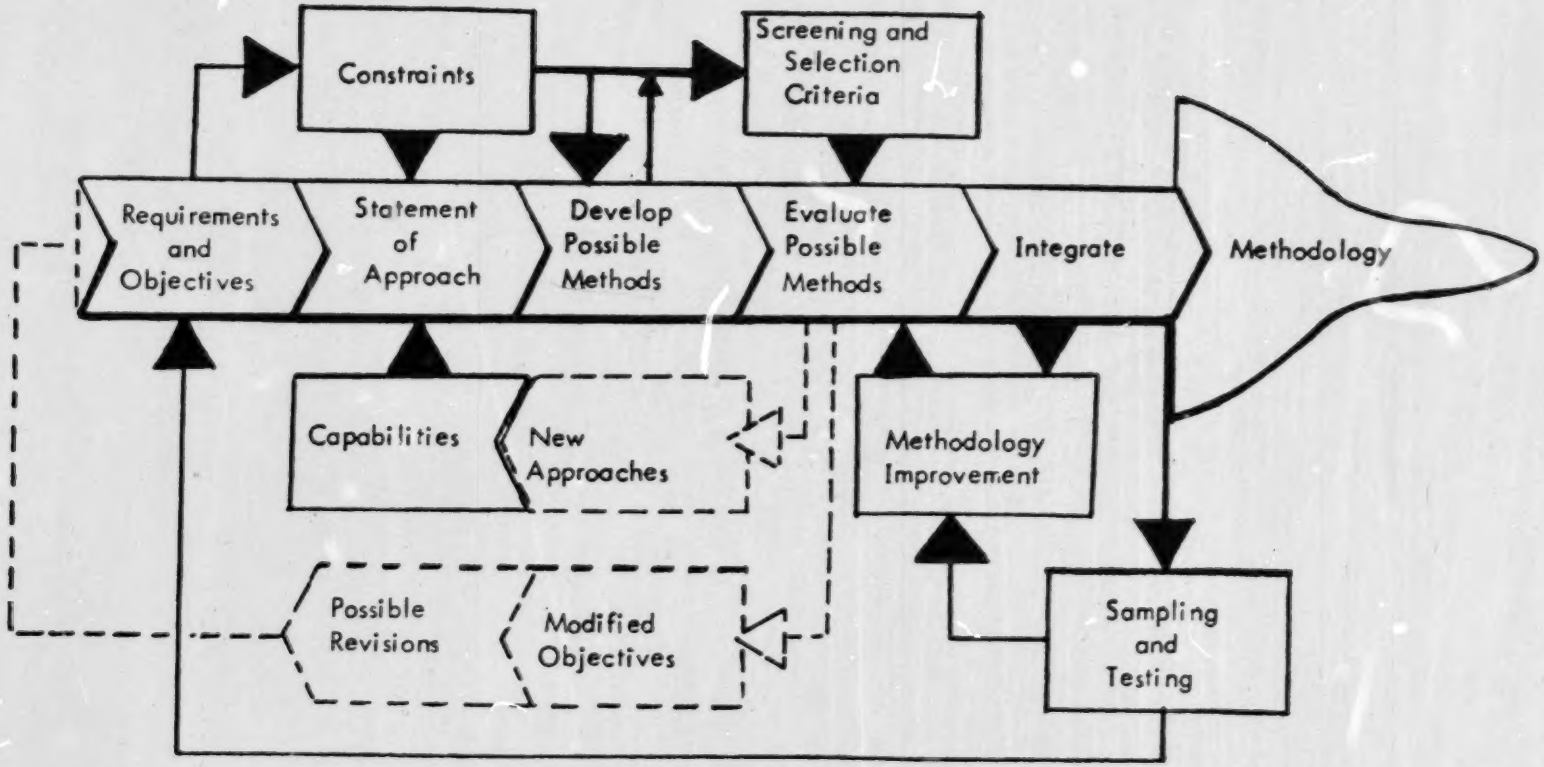

Figure 2. Methodology Development for ED-PLUSS Study

- Develop Possible Methods--In this case, a listing of methods and techniques for exploring the user community for educational user applications and techniques unique to the educational community should be developed. Demonstration programs and the use of consultants, among others, are examples of applicable methods. In each case prime consideration should be given to attaining the stated objectives.
- Screening and Selection Criteria--This key element requires careful analysis of such crucial parameters as risk, cost-effectiveness, performance and timing as they affect the establishment of priorities and the refinement of policy decisions.
- Evaluate Selected Methods--Some methods will prove more effective than others. This evaluation process will eliminate those contributing the least to the attainment of the stated objective. Potential market programs for expanding the utilization of SS/SL at each educational level would be identified by this stage and a tentative plan of action laid out to match the needs and interests of buyer and seller.
- Integrate--In this most important element, synthesis would be performed to integrate the selected methods into a well-defined and functional program.
- Sampling and Testing--A determination of effectiveness of the developed methodology should be made. Feedback loops to investigate the possibility of revising the original objectives or further refining the methodology could be applied at this stage.
- Futures Analysis--Throughout the methodology development process the futures context must be given to potential changes in objectives, capabilities, and constraints among the buyer, seller, and interface functions.
- Display of Output--The developed methodology for meeting a particular set of objectives and requirements may take a variety of forms. Usually, a flow diagram or matrix of some type is prepared to assist in communication and to more clearly show the flow of activities required and their relationships. A typical methodology for the development of SS/SL uses and users from government agencies is given in the Stanford Research Institute Phase I study. The techniques and organizational recommendations provided in the Battelle Phase I report should particularly apply to Level III of the educational community. From these Phase I studies numerous methodologies could be developed and displayed.

Methodology Application

In order to apply the methodology shown in Figure 2, a free flow of information between NASA and the educational community must be established so user needs, capabilities, constraints, resources and other items of critical interest can be shared with NASA personnel. The same type of information must flow from NASA to the user community so

judgements and decisions might be made on a basis of knowledge of the others ability rather than on hoped for capabilities.

Any techniques developed from use of this methodology as applied to NASA's search for new SS/SL users should at least address the following considerations:

- Long-range planning strategies
- Understanding of user needs and priorities
- Technological assessment of the state-of-the-art at time of program operation
- Cost-effectiveness of selected methodologies compared to alternatives
- Program objectives clearly stated and related to overall strategies
- Pricing plan (cost of goods and services)
- Life cycle analysis
- Technical feasibility
- Alternate approaches
- Schedule of key events
- Implementation tasks
- Key management decision points
- Clear communication channels
- Motivational aspects

During the course of early follow-on activities to this contract, preliminary flow charts which can display a methodology for a particular level of educational application for the SS/SL should be developed. Also, sampling of the proposed methodology is needed by requesting comments from selected contacts made during this study. In this way, developed methodologies can be tested by an early review of their validity and content.

TASK 4 METHODS TO ENCOURAGE USER AWARENESS

Task 4 includes two elements. One is the identification of educational networks or focal points for coordination of the interface necessary to meet regional needs. The other is the identification of techniques that may stimulate greater user awareness of SS/SL capabilities.

Educational Networks Consideration

Five basic networks have been identified as potential vehicles of contact with the educational community.

- Administrators--Superintendents, university presidents, industrial training managers and their key staff members should be contacted in a search for common needs.
- Federal Agencies--Key leaders in these agencies need to be made aware that SS/SL has something to offer their educational programs.

- Educational Communication Networks--There are many educational radio and tele-communication networks in the country with capabilities to offer for desirable applications of SS/SL.
- Regional Education Service Agencies--Many of these agencies may serve as model networks for SS/SL interface with regional education needs.

Typical Methods/Techniques Considerations

The following methods may be utilized to stimulate user awareness of the potential uses of SS/SL.

- Consultants--Special people or teams who can translate the technical capabilities of SS/SL into laymen's terms.
- Publications--Printed materials for dissemination to educational groups concerning SS/SL capabilities.
- Conferences--Meetings of specific target groups within the educational community.
- Demonstrations--The Appalachian Educational Satellite project of the University of Kentucky using ATS-6 is a typical example of a demonstration program that can be effective in showing SS/SL capabilities applications.
- Workshops--Organized experience for selected target groups.
- NASA Tours--Bring groups of interested educators to NASA Centers to see what is being done in SS/SL applications.
- Seminars--A means of group education about SS/SL capabilities.
- Science Fairs--Exhibits at science fairs will reach many interested students who may become future users of SS/SL capabilities.

TASK 5 COMPILE "FOLLOW-ON" IDEAS

A brief description of some of the ideas having potential interest to NASA for expanding educational applications for the SS/SL are presented below:

- Surveys, Interviews, and Questionnaires
  After studies have revealed the nature and identity of potential educational users, surveys could search for attitudes and ideas held by the individuals concerned. Interviews and questionnaires could be used to probe for levels of commitment, resource requirements and availability.

- Contacts and References
  A comprehensive listing of key contacts and references, developed by the ED-PLUSS study, should be enlarged to provide individual names, organizations and background information on a variety of potential users and advisors for SS/SL educational applications.

- Workshops
  During the Phase II period, it is recommended that two or three day workshops be conducted at key points throughout the country for key educational leaders from various disciplines. The purpose of these would be to present the scope and capabilities of the SS/SL and solicit ideas for educational applications.

- Presentations
  It is proposed that efforts be made to have speeches and programs developed for presentation in general or "departmental" sessions of regional and national educational association meetings. These would emphasize potential educational applications of SS/SL.

- SS/SL User Sourcebook
  A loose-leaf SS/SL User's Sourcebook describing the capabilities and educational applications of the system is needed as an aid in contacting the educational community. This book would include background information and emphasize various benefits of using the SS/SL capabilities to help solve some of the pressing educational problems.

- SS/SL Information Van
  For the educational community a mobile van could be designed for use to universities, industries, etc. to contain all the models and media necessary to bring an awareness of SS/SL capabilities to the potential educational user.

- CVT Pilot Studies
  Experimental testing or pilot studies for educational experiments could use the NASA Concept Verification Testing (CVT) concept. This would verify the validity of an experiment prior to its actual implementation.

- Contract Commitment for Education
  In order to extract the maximum educational value from SS/SL experiments contracts with industry and government users might contain some type of commitment to make some types of information about them freely available to educational users.

- Geographic Evaluations
  It is suggested that geographic evaluations be made to relate the widespread NASA centers that already exist more closely to the educational community, particularly as regards their potential contribution to educational programs and problems.

- International Cooperation
  More work should be done on the development of cooperative international programs using SS/SL. The educational element might prove to be the common bond that will unite many different countries and cultures into joint SS/SL programs.

Additional Follow-On Ideas

The following ideas were considered of sufficient value to include in the final report. They are presented for additional review and possible expansion.

- Investigate methods to gain broader involvement of the humanities into the SS/SL program.
- Investigate the possible application of the ED-PLUSS study format, as developed in Phase I, for evaluation of other national goals.

- Develop methods for encouraging broader educational utilization of planned SS/SL experiments.
- Investigate techniques for improving communication and liaison between potential educational users of SS/SL.
- Investigate the use of science fairs and student design competitions as breeding grounds for SS/SL educational programs.

ACKNOWLEDGMENTS

This work was supported by the National Aeronautics and Space Administration, George C. Marshall Space Flight Center, under Contract Number NAS8-30737. Mr. Ron Crawford and then Mr. Charlie Johnson were the NASA Contracting Officer Representatives for the project and their coordinating efforts, encouragement and consultation during the course of the study are appreciated. Likewise, many other NASA personnel provided essential data and helpful suggestions.

Appreciation is expressed for the cooperation and support gained from the other three Phase I contractors and the key contacts made throughout the educational community. Special appreciation is given to the seventeen members of the UAH ED-PLUSS Advisory Committee.

Mr. Sandy Campbell, graduate assistant, and Mr. Harold Green, educational consultant, are particularly recognized for their extensive research and supporting efforts on this study. As task team members, they served throughout the course of the project in a meritorious way. Mr. Mike Malin, Mr. David Fradin, Dr. Harold C. Steele, and Dr. Robert Morgan provided valuable consulting and advisory service which deserves special recognition.

The manuscript was typed by Wilba Newby, who also served as secretary and gave her full support to the project team in accepting and completing a variety of tasks. Her patience and skillful typing were essential to this effort.

A WORD OF APPRECIATION

In its continuing program of cooperation with the National Space and Aeronautics Administration, the University of Alabama in Huntsville looks forward with interest to developments in the area of educational applications of all space technology. It hopes to be a contributor to them as the time for the first flights of SS/SL draws near.

The University wishes to express its appreciation to NASA for the opportunity to participate in the program of development of new uses and users of SS/SL. It also appreciates the comments expressed by Dr. Wernher von Braun in his interviews with Dr. Harry Engle, Mr. David L. Christensen, and Mr. Sandy Campbell, all of the ED-PLUSS team. They have proven of great worth in visualizing the long-term values of space to education.

Special appreciation is expressed to Mr. Harold Green for his time and efforts in preparing this executive summary.

Memorandum from The University of Alabama in Huntsville ED-PLUSS Study Team,

NASA Contract NAS8-30737

The National Space and Aeronautics Agency (NASA) has for some years been engaged in the development of the first reusable Space Transportation System (STS). Building on the experience gained in space flight from Vangaurd to Skylab, the first space system whose purpose is not primarily experimental is taking shape under the watchful eyes of a generation of astronauts and engineers who have probed the frontiers of knowledge, and looked into the future, to bring us our first glimpses of what benefits for man lie in the space beyond the sky.

Like most other Americans, your life will be profoundly affected by the Space Shuttle/Space Lab (SS/SL) program in the years that lie ahead. Regardless of your present profession, your work will, we believe, be significantly altered by the activities made possible by SS/SL. Most important of all, the education of your children, and their children, will not be what yours was, because of what SS/SL can make possible.

Some of the changes that might lie ahead have been anticipated. These are discussed in the attached comments of Dr. Wernher von Braun, for many years the leader of the NASA-MSFC team, in an interview with the ED-PLUSS team members. NASA contracted for studies with several companies. Likewise The University of Alabama in Huntsville was funded to perform a Phase I research effort to provide some basic methodologies for exploring the potential user community.

Since education is the prime purpose of The University of Alabama in Huntsville, this institution studied educational aspects of SS/SL capabilities and potential educational uses and users.

This document is a brief summary of the final report that resulted from this contractual effort. The final report is available from NASA.

We hope you find it stimulating and helpful in your future thinking about yourself, your profession, SS/SL, and space.

Attachments:

Executive Summary, Contract NAS8-30737
Letter and Interview with Dr. Wernher von Braun
Microfiche Copy of Final Report

School of Graduate Studies
And Research

Center for
Environmental Studies

The University
Of Alabama
In Huntsville

P.O. Box 1247
Huntsville, Alabama 35807

January 28, 1975

Mr. Richard L. Brown PM01
Mission and Payload Integration Office
Marshall Space Flight Center
Huntsville, Alabama

Dear Mr. Brown:

As a part of the extended contract activities on the UAH ED-PLUSS Program (NASA Contract NAS8-30737) we are hereby submitting the transcript of an interview held with Dr. Wernher von Braun, Vice President of Fairchild Industries. This interview was held in Huntsville, Alabama on October 8, 1974 with members of the UAH ED-PLUSS team. The purpose was to review the ED-PLUSS Program with Dr. von Braun and solicit his comments and suggestions on educational applications for the Space Shuttle/Spacelab (SS/SL) Program. Particular emphasis was placed on the ATS-6 program and its application to future educational satellite programs.

Dr. von Braun indicated that several key factors should be addressed to enhance broader utilization of the SS/SL for educational purposes. Among these were the following:

1. Greater awareness of geographic, regional and cultural considerations is needed to improve effectiveness of the educational programs at the user level.

2. Generally the use of space and satellite broadcast technology for educational purposes has been well received and effective as a teaching aid.

3. The programming and software problems associated with educational satellites is considerably more significant for realizing their effective utilization than are the associated technological problems.

4. The effectiveness of ATS-6 and similar educational demonstrations is severely hindered by a lack of follow-

through and continuity. Funding limitations appear to be the primary restriction to realizing more positive and long term program results.

5. Real-time astronomical observations from orbit appear to offer unique advantages for educational programs including the training of students and related research. Educational programs in meteorology, oceanography, and environmental sciences could also have much to gain from the observational capabilities of SS/SL.

6. Mobile facilities for research in the Antarctica can provide an excellent model or analogy for SS/SL experimental programs requiring University research. Similar operational and safety considerations within an unique environment are required in each case, and real-time involvement is needed in both situations.

7. A dedicated educational satellite program could provide efficient and beneficial services to American trust territories in the Pacific Ocean area. Joint sponsorship by several government agencies should be investigated to implement such a program.

Potential follow-on activities related to the above comments and to other ED-PLUSS Program recommendations are being prepared for transmittal under separate cover.

Sincerely,

David L. Christensen
Research Associate

DLC:sr

Attachment: Interview Transcript

cc. Dr. E. Rush
Dr. K. Johnson
Mr. G. Goodin

INTERVIEW OF 10-8-74 WITH DR. WERNHER VON BRAUN
VICE PRESIDENT, ENGINEERING & DEVELOPMENT
FAIRCHILD INDUSTRIES, INC.

(David L. Christensen) This is October 8, 1974. We are meeting with Dr. Wernher von Braun in the Alabama Space and Rocket Center conference room in Huntsville, Alabama. Attending the interview are Dr. Harry A. Engle, Mr. Sandy Campbell, and myself, David L. Christensen. The purpose of the meeting is to discuss with Dr. von Braun the utilization of educational satellites for the Space Shuttle and Space Transportation Systems of the future. This effort is part of a continuing research program at the University of Alabama in Huntsville. The project title is ED-PLUSS, which stands for Educational Planning for Uses and Users of the Space Shuttle and is funded by NASA.

(Dr. von Braun) I am pretty well familiar with what you are trying to accomplish and as I understand it, you want me to put my two bits in here and there.

(DLC) Right. We have gone beyond the mid-term report, which you have reviewed. We want to show you very quickly what we have been doing in the interim. We will discuss the current ATS-6 satellite educational programs, its potential follow-on, and then - this is of interest to us - a marketing discussion on techniques and methods for utilizing educational satellites. I know you have been involved in all of this. Then, if we could, let's brainstorm a little at the end, and look into the crystal ball for future ideas.

(WvB) The area in which I could probably most directly contribute to what you are trying to do here is to tell you about our practical experience with satellite users. Maybe we could discuss their problems and the hang-ups they have about this thing

and where one could improve things a bit. My comments would cover not only some experience with foreign countries but also remote areas within the United States, in particular Alaska. I recently visited some villages in Alaska where health care and educational television by ATS-6 are presently in use and talked to a lot of people to get their feeling. We have been telling ourselves so often what great things direct broadcast T.V. could do for such people in remote areas that we were eager to find out what the impact really was.

(DLC) Could we just tell you briefly the background on the ED-PLUSS program? These are our final briefing charts which we can review very quickly with you. We performed several tasks and we did this as a Phase I study. We worked with three other contractors, Battelle, Arthur D. Little, and Stanford Research. We are all working as a team to investigate uses of the Space Shuttle for new applications beyond what NASA has identified. So now it goes into a Phase II program. We looked at different levels of education. We structured this and we looked at different expenditures and funding as a sort of market survey. This is all discussed in detail in the report. Then we identified some basic needs common to all these levels to consider something pertinent and related to the space program. We then arrived at certain conclusions, which I won't go into but these were pulled right out of the report, as shown on this briefing chart. Then we looked at NASA to see what they had been doing with the field of education, identified certain groupings, you might say, and recommended certain activities which could have an impact in the future on the space shuttle program. We also developed a scenario to help explain how all this fits together. Here we show educational satellites, such as the ATS-6, and we show how it could be interfaced with Level 1, 2, and 3 educational activities, involving teleconference rooms,

libraries, student instructions - the things you are very familiar with. Then we went into the dissemination program, also going through this loop to help support activities on space shuttle. Here we get into the student investigations such as on the Skylab Student Experiment Program, and all the research people in educational institutions involved in experiment programs. Then we looked at educational experiments from orbit where, for example, you might evaluate environmental parameters with ground truth measurements, using students on the ground and trying to loop together. You link these things, of course, in real time through an educational satellite program so that it becomes a working system that is self-sustaining or self-supporting. That is the scenario we would like to evolve out of this.

Then we worked up a systems approach to develop techniques and methodology to apply these ideas in a very systematic way. These are all described again in the report, so we basically suggested to NASA, "Look, here's your tool and this is what we think you should do to arrive at the next step." Then we developed a matrix showing the educational categories and the interfaces and also, the NASA offices and their educational capabilities and tried to relate these things to each other. Of course, this has to be applied to the futures context so it becomes three-dimensional, which makes it very complex to weave your way through the whole pattern. Out of this we also came up with some different techniques for stimulating educational use and we describe the use of consultants, seminars, workshops, and particularly, demonstrations, such as ATS-6. It is valuable when you can actually see these things demonstrated. Teachers here in Huntsville really reacted favorably to this whole program. We sat in on the press conference here and it was really an eye opener. Dr. Engle might want to comment on this.

(WvB) Did you particularly concentrate on the methodology?

(DLC) Yes, at this stage.

(Dr. Harry A. Engle) Basically, yes. But our basic objective was to identify and evaluate new users and uses. The other contractors concentrated more on market methodology. We attempted to say, "Where is this market?"

(DLC) "And where do we go from here?"

(HAE) Rather than each coming up with only a methodology, we have a combination of things. We think we went one step beyond the others.

(DLC) Arthur D. Little looked at the front end problems - the policies and decisions NASA needs to address and the need for a tariff model, the pricing structure, and all those things which are essential before they get into operational programs.

(WvB) Would it be useful for you if I gave you some of my own private thoughts? I think your methodology is in perfect shape, and I don't want to add any more because I think it is very well thought through. Let me first say what my exposure was. I had quite a few talks with people in India. I saw how ATS-6 works in Appalachia, and now most recently, in Alaska. The fundamental problem is, of course, that the people say, "Well, it may take only a few weeks to demonstrate the technical soundness of the direct T.V. broadcast experiment, - the fact that you can really provide good pictures in the villages - but it will take years before you will have learned doing a good job in using this new educational tool. This is a social experiment involving thousands of people and there is a lot of trial and error involved in the development of effective

programware." Programs that may be good for one environment may be completely useless for another. Their effectiveness depends on geography, traditions, ethnic and religious hang-ups, and regional value systems. For this reason the main complaint we hear is that NASA has not completed its job, that NASA has stopped with the purely technical part of the demonstration. NASA, they complain, provided ATS-6 and said, "OK, here it is. You have it for one year in Appalachia, Rocky Mountains, Alaska. Then we will move it on to India." The critics are entirely right when they say you can't work like this when thousands of people are involved who are trying to find the best way of using this as a new educational tool. There are bitter complaints about NASA being prevented by the Office of Management and Budget (OMB) from finishing the job it had tackled with so much dedication and competence. OMB says to NASA: " Look, your NASA mission is to demonstrate the basic technical capabilities of your new applications satellites. If there is a real need for this sort of thing, then let HEW or whoever the logical user is establish an operational use program and come back to OMB and request the funds for it." Now HEW cannot possibly be expected after one year of experimentation with direct TV broadcast education to specify a long-term nationwide operational program. So, the net result is, we have this beautiful thing here, but there is no effective follow-up. The potential benefits of a highly successful $200 million experiment paid by the American taxpayer are falling between the cracks. We were told just a few days ago that any continued funding for the back-up for ATS-6, the nearly completed ATS-7, probably will now be terminated. It is a dead-ended thing. For space applications to become really useful, there must be continuity in all of this. There must be an orderly and funded transition process from the developing to the using agency.

There are also many cases where money can be saved through satellites

right now. For example, are you familiar with the Veterans Administration? There are several hundred VA hospitals in the U.S., most of them quite small. They have a perennial dilemma. They say, " We just cannot spare our only doctor here in our small-town, 10- bed hospital, to go on a training course to get an up-date on the latest treatment of diabetics or something like this." Now if you could keep that doctor in his hospital by providing him with a direct satellite-broadcast television program, where he can bone up on these things, he could continue to do his hospital job and at the same time get a professional up-date. Just think of the savings and gains in medical proficiency this could bring about. The same can be said for teachers. In Appalachia, the response we got was generally, "Well, I have been teaching classes for years, but now with this ATS-6 satellite you can get a first-class up-date the night before. They brief you once more on the topic you'll cover in the classroom and even give you a few hints on how to get the story across a little better to those kids. I feel I'm really five times as effective a teacher as I've been before."

Now many people are concerned about the development of programware or software. An educational satellite is a voracious thing, you know. It sits up there in the sky and demands to be fed with programs for eight hours a day. Few people realize the magnitude of that programming task. We have been telling ourselves for years that the greatest value of educational satellites is that they offer you an interacting system where the teacher does not only teach one-way, but where she can also test the kids. In the simplest form this may be done with a multiple choice answer system where the teacher asks via television channel, "What is the right answer, Option III, Option IV, II, or what?" The kids then push the appropriate button of their choice and the signal goes back to the satellite. The satellite

registers the replies and comes back after 5 seconds with the announcement that 60% of the kids say Option III is the right answer. Here again, we have something undoubtedly of tremendous potential for remote areas in this country and for developing nations.

But where is all this heading with OMB's unimaginative attitude?

In India educational satellites such as ATS-6 and its operational follow-ups will also have uses of great significance. India, too, will use them for elementary education in their 500,000 villages. But they will also use them to instruct farmers about things like better fertilizers and how to use them to grow more corn or wheat or rice. I saw a major instructional experiment along these lines recently, that involves a terrestrial TV station in Delhi and some 100 normal TV receivers distributed to nearby villages. The program I saw in one of these Indian villages was quite corny but extremely effective. You see a guy arriving in a village in a jeep. He carries a suitcase and assembles a few farmers around himself and cracks a few jokes in the local idiom. Then he opens his suitcase and says, "Look what I have here, a chemical fertilizer", - nobody had even heard the word before. He unpacks his suitcase and says, "Have you decided what you want to grow? Do you know what kind of soil you have?" Next he shows them how to make a soil analysis. He takes some bottles out of his case and scoops up some dirt and adds some of his fluids. Then he lets one of the local farmers do it, with lots of laughter and a few dumb jokes. These presentations go over beautifully because the village people can relate to what they see and hear. They may even recognize a face here and there or they may say, "Isn't that our neighboring village?" It is also very important for the presentor to use the local idiom. An Indian who knows the United States very well told me, "Suppose you wanted to teach an Alabama cotton picker via T.V. some better methods to pick cotton; would you do it in a Bostonian accent? The guy would probably feel offended or he may not even understand what was being said and turn the set off. You have this kind of problem in India all over the place." There are many dialects and even many different languages. Also, farmers have different problems in different regions. For instance, you don't talk about cotton picking to a guy growing wheat in Wisconsin or raising sheep in Wyoming. You have to pick the right subject for your specific audience and present it in a folksy idiomatic way to the people you are addressing.

(HAE) We have tried in the body of our study to talk about regionalizing needs to get the input from these people as to what their real needs are rather than someone on the national level determining it.

(DLC) We addressed that part in detail.

(WvB) I have the feeling it would be a great mistake to go to these villages with sophisticated software developed by places like the Harvard Business School. With their glib, slick language you'd simply be talking above everybody's head. Their sophisticated words, their language, their entire approach is just not corny, not folksy enough.

(DLC) That's a valuable input. Could we now look into the crystal ball a little beyond ATS-6?

(WvB) There is, of course, the big question: How do you tie the future world-wide educational and scientific satellite programs together with the future Space Shuttle? And what could the universities do to get ready for this new phase?

Let me start with a scientific program, the Large Space Telescope (LST). I think in future astronomical courses at universities, young astronomers should be exposed to the vast new research opportunities that the LST, carried aloft and supported by the Shuttle, will offer them. You see, in astronomy you have a situation where the high priests still have the first draw on the big cathedrals, the instruments. A distinquished gent who is well established and maybe has the Nobel Prize just hollers and gets the Palomar reflector for a week. But the young postgraduate student, while he may be a lot more up to date, often has a hard time to get even close to some of the choice instruments. There are lots of young astronomers today who say, "I have still one advantage going for me. That old graybeard will never go to orbit in the shuttle, but I will! And so I should try to go into astronomy programs where I, as a member of the young generation, have a unique advantage over him. I would like to prepare myself for future shuttle-supported astronomy tasks which are not suited for these older gents." This means, of course, that astronomy courses should cover future shuttle-supported astronomy research plans. They should cover science experiments that you can do on the shuttle but not on the ground. An outstanding feature of shuttle astronomy is, of course, that the entire electromagnetic spectrum is at your disposal, whereas, on the bottom of the atmosphere you can only observe the frequencies for which the earth atmosphere is transparent. That means the shuttle offers plenty of new opportunities for planetary observations, solar astronomy, infrared, ultraviolet and X-ray stellar

astronomy, etc. If I were a young astronomer and somebody offered a course in my university labeled "Astronomical Observation Opportunities Being Offered by the Shuttle-Supported Large Space Telescope", I would jump at the opportunity. Although you may not always get the precious Large Space Telescope assigned to your program there is still the more versatile Spacelab with its smaller pallet-mounted battery of telescopes. They may not match the big aperture of the LST but still offer the full spectrum capability.

Young scientists can also pursue other objectives in the Shuttle. Looking down onto the earth they can work in meteorology or oceanography. So let's identify science programs that require man's being up there, and prepare budding students for these tasks in well-structured university courses! You will attract the young scientific generation because again they know the old men can't make it and are less of a competition. If I were a young man interested in any of these fields involving earth-observation from the Shuttle - I would hope my university offered courses to prepare me for my role in this.

I don't think I am talking here about something fantastic because I have seen a very similar trend during my 1968 visit to Antarctica. During each Antarctic summer - which is our winter - an average of 300 to 500 American young scientists and postgraduate students are down there for about three months. The typical mode of Antarctic research today is for a guy to identify a scientific objective that he wants to pursue - whether it is the love life of the penguins or something on glaciology or meteorology in Antarctica. One guy I met was studying the iron deposits on the clean Antarctic ice and snow cover caused by shooting stars! They offer a historical record on both snow deposits and shooting star abundance going back over a thousand years. There are lots of interesting topics like this. The applicant works out a study proposal and submits it to his Professor. The university passes it on to the National Science Foundation. If they like the proposal, they may underwrite it, which means they pay the fare of flying the student down there, they pay for the modification of the Antarctic house trailer that goes out there, and if the student is married, they pay a little salary to his wife who's left behind. After the guy has collected all the data he needs he returns from Antarctica, goes back to his campus, writes his thesis, and gets his doctor's degree. That's the way much Antarctic research is conducted these days.

You know, you don't go to the South Pole anymore with dog sleds. Instead, they move a well-insultaed house trailer onto your campus, say, at the University of Wisconsin. During the summer preceding your Antarctic trip you put all your research equipment into that house trailer and check it out. For example, if you want to study the aurora australis in Antarctica, you try out your instrumentation on the campus, using an artificial radiation source for calibration. By the time your house trailer is ready to be moved down to Antarctica it has become an entirely familiar environment for you. You turn the trailer over to the Navy, they put it in a cargo plane and fly it directly down to the ice. When you arrive, you find your trailer burried under the snow and ready for work. Everything is still in there, even the pin up girls you pasted on while the trailer was still on the campus. I think this is very similar to the operational mode we can foresee for the Shuttle - just replace the Antarctic house trailer by the Spacelab. Antarctic researchers don't necessarily get a brand-new trailer either. The trailer assigned to them has probably been on the ice five times before he gets it assigned for his particular program. The Spacelab, too, will be brought to the campus and prepared there with its special mission-related research gear, flown to the Cape, placed into the Shuttle orbiter, and flown up to orbit along with investigator. A week or sometimes even a month later he comes back with all his data and writes his thesis.

I think it is vital to tell young people that this sort of thing will be available to them. There will be this fabulous new opportunity to address many scientific challenges with the new powerful research tools offered by the Shuttle and the Spacelab.

(DLC) This is one we didn't include as a model, but we certainly will in our supplementary report.

(WvB) Even the safety aspects of research in Antarctica and future research in the Shuttle have certain similarities. A postgraduate student in astronomy working on his doctor's thesis by using the Shuttle-supported Large Space Telescope will undoubtedly have to undergo a cram course for living in the zero-gravity environment of the Shuttle for a week. The Anarctica guys get a similar cram course on what it is like to be in Antarctica. The way it works out there for that researcher is that the Navy keeps him alive, feeds him and flies him out or brings in the doctor in case he gets sick. This logistics support is a different world

altogether from his scientific research program. There are a few things even the well supported researcher has to know, of course. For example, what do you do in case your house trailer catches fire, which, strangely enough, is considered the greatest single hazard in the Antarctica? You see, if you wake up and find the thing is filled with smoke, you may reach for the fire extinguisher. But if that fire is not out quickly and you are forced to get out with a 40 mile wind blowing outside and you get out there in your pajamas, you are good for about one minute. Yet there is a very simple solution to that problem. They just bury a big wooden crate under the snow nearby. It contains well insultated sleeping bags, a sterno cooker with some food supply, and an emergency radio. It is the equivalent of a lifeboat.

An emergency in space is really not too different. There is no immediate requirement to return to earth. If you have a fire in your spacecraft and its interior becomes unlivable, you first need an emergency cocoon. For the time being it provides you all the safety you need. You are not about to die because you are in a stable orbit. You are just as safe as in that little crate in Antarctica that keeps you warm even when there is a blizzard outside. People have to know these little tricks before they can or should go out, - to Antartica or to orbit. For your purpose, Dave, let me say that this sort of information should be presented in training courses to prepare the kids properly.

(DLC) We are even planning a proposal along this line from the University to NASA, so we do plan to pursue this.

(WvB) I have one entirely different subject which may or may not fit into your study. I believe an educational program can be of very great political value to America in what is called the Pacific Rim - the western rim of the Pacific Ocean. Are you familiar with the East-West College in Hawaii? The purpose of that school, in a nutshell, is to bring in students from Japan, Korea, the Philippines, Viet Nam, and Thailand, and expose them to the American way of life and thinking, but do it in a semi-oriental environment, namely in Honolulu. The guys are then sent back to their respective countries in the hope that they will become leaders there. Now the countries that I just mentioned are indeed sending numerous students to that East-West College. But America also has those vast territories in Micronesia, American Samoa and so forth. Most people living on these hundred of islands actually have very little evidence of being citizens of American trust territories. We don't like to call these islands colonies, but nobody knows what they really are. They

are neither fish nor fowl. They have no national identity and if they like us they do it in a vague way because they really do not know very much about America.

They have orphan status. I guess about the only way they are occasionally reminded that they belong to the American orbit is when every now and then the Navy sends a destroyer there and shows the flag. Now with the help of an educational satellite beaming a well thought out program into these Pacific Rim islands, we could really pull them into the American orbit. I think, and that may be a very personal opinion, this sort of positive approach to provide an American presence would be much more effective and lovable than fighting a war in Viet Nam. I am sure the local people would endorse such a satellite service whole heartedly. And I think even for the Department of Defense this would be a most cost-effective way of spending the defense dollar in the western Pacific.

(DLC) Have you proposed this, or is it just sort of a gleam in your eye right now?

(WvB) A very knowledgeable man brought this idea to my attention. Have you heard of Rex Lee? He used to be Governor of American Samoa during the Kennedy administration. He introduced educational television in American Samoa more than ten years ago. He wanted to set up a first class educational system in Samoa, but not by importing hundreds of American school teachers who would only deprive the children of their native heritage. He wanted to have the kids first raised in their native culture and language, and bring in the English language and the American culture later. Since there were not enough native teachers Rex Lee brought the American Educational Television Association into the act. They looked over the island and told him that it was tailor-made for educational television. They put a television transmitter on central Rainmaker Mountain on American Samoa to cover the various villages scattered around the periphery of the island. I saw that system in 1968 when I came back from Antarctica and was greatly impressed. Rex Lee later became Commissioner of the Federal Communications Commission. He also knows Alaska very well. That's why I invited him to attend a meeting we had a couple of weeks ago in Germantown, Maryland, with a group of Alaskans interested in better communicatons for social services. That's where he brought up the question of similar services for the Pacific Rim. "American Samoa was only one little island,"

he said, "and educational television was highly successful there. With the help of a satellite you could provide that same kind of service for all these many islands in the Pacific Rim".

(DLC) That would be nice joint venture between DOD and NASA for using the educational satellite.

(WvB) I would suggest that you throw it into your hopper, Dave. Maybe someone will read it and pick it up.